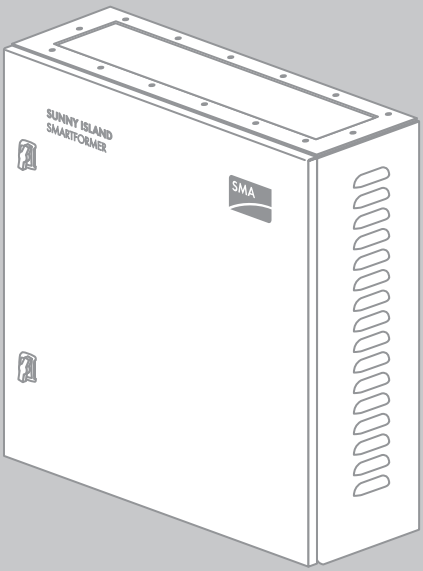
Accessories for Sunny Island

SMARTFORMER FOR SUNNY ISLAND

Installation Manual



SI_TDBOX-IA-eng-IUS122211 | IMEN-SITDBOX-US | Version 1.1

US

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SMA America, LLC
3801 N. Havana Street
Denver, CO 80239 U.S.A.

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important instructions for the following product:

- Smartformer for Sunny Island

This manual must be followed during installation and maintenance.

The product is designed and tested according to international safety requirements, but as with all electrical and electronic equipment, certain precautions must be observed when installing and/or operating the product. To reduce the risk of personal injury and to ensure the safe installation and operation of the product, you must carefully read and follow all instructions, cautions and warnings in this manual.

Warnings in this document

A warning describes a hazard to equipment or personnel. It calls attention to a procedure or practice, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the SMA equipment and/or other equipment connected to the SMA equipment, or in personal injury.

Symbol	Description
⚠ DANGER	DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	NOTICE is used to address practices not related to personal injury.

Other Symbols in this document

In addition to the safety and hazard symbols described on the previous pages, the following symbols are also used in this manual:

Symbol	Description
i	Indicates information that is important for a specific topic or objective, but is not safety-relevant.
☐	Indicates a requirement for meeting a specific goal.
☑	Desired result
✖	A problem that could occur

Markings on this product

The following symbols are used as product markings with the following meanings.

Symbol	Description
	Warning regarding dangerous voltage The product works with high voltages. All work on the product must only be performed as described in the documentation of the product.
	Risk of Fire Improper installation of the product may cause a fire.
	Beware of hot surface The product can become hot during operation. Do not touch the product during operation.
	Observe the operating instructions Read the documentation of the product before working on it. Follow all safety precautions and instructions as described in the documentation.
c UL us	UL1741 is the standard applied by Underwriters Laboratories to the product to certify that it meets the requirements of the *National Electrical Code*®.

General Warnings

⚠ WARNING

General Warnings

All electrical installations must be done in accordance with the local and *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1. This document does not and is not intended to replace any local, state, provincial, federal or national laws, regulation or codes applicable to the installation and use of the product, including without limitation applicable electrical safety codes. All installations must conform with the laws, regulations, codes and standards applicable in the jurisdiction of installation. SMA assumes no responsibility for the compliance or noncompliance with such laws or codes in connection with the installation of the product.

The product contains no user-serviceable parts. For all repair and maintenance, always return the unit to an authorized SMA Service Center.

Before installing or using the product, read all of the instructions, cautions, and warnings in this manual.

Before connecting the product to the electrical utility grid, contact the local utility company. This connection must be made only by qualified personnel.

Wiring of the product must be made by qualified personnel only.

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1 Information on this Document

Validity

This document applies to device type SI-TD-BOX, hardware version 1.0 and higher.

Target Group

This document is for skilled workers. Only qualified personnel are allowed to perform the tasks set forth in this document (see Section 2.2 "Qualification of Skilled Workers", page 13).

Typography

Typography	Usage	Example
"light"	• Terminals • Spring clamp terminals • Screw terminals	• Connect the L conductor of the AC 1 terminal of the Sunny Island to the lower spring clamp terminal in connecting terminal plate "Sunny Island AC1 L".
bold	• Switch settings that you should select	• To have the connected loads supplied by the Sunny Island, set the bypass switch to **I ON**.

Nomenclature

The following nomenclature is used in this document:

Complete designation	Designation in this document
SMA Solar Technology America, LLC	SMA
Smartformer for Sunny Island	"Smartformer" or "product"
Sunny Boy	PV inverter

Abbreviations

Abbreviation	Designation	Explanation
AC	Alternating Current	–
DC	Direct Current	–
PE	Protective Earth	–
PV	Photovoltaics	–

2 Safety

2.1 Intended Use

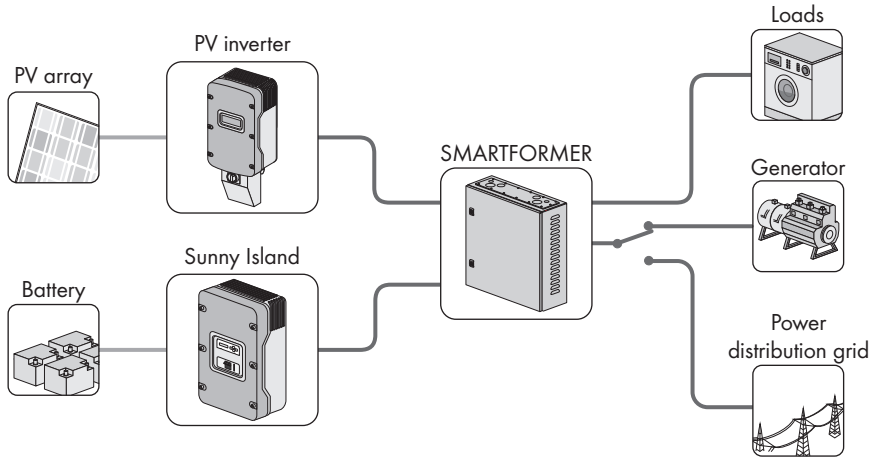


Figure 1: Principle of a simple Sunny Island system with Smartformer

The Smartformer for Sunny Island is a pre-wired AC distribution board with an autotransformer, bypass switch, load-shedding contactor, overload protection, and miniature circuit-breakers.

Mounting requirements:

The Smartformer is only suitable for indoor use. Do not mount the Smartformer outdoors.

- Do not mount the Smartformer on flammable construction materials.
- Do not mount the Smartformer near highly flammable materials.
- Do not mount the Smartformer in potentially explosive atmospheres.

Electrical connection requirements:

The Smartformer must only be used with the following Sunny Island inverters:

- Sunny Island 4548-US / 6048-US
- Sunny Island 5048-US with labeling "Smartformer compatible" on the original packaging

  Sunny Island 5048-US inverters without labeling "Smartformer compatible" on the original packaging require an additional fuse outside of the Smartformer for Sunny Island (see Section 6.3 "Selecting Cables", page 36).

The Smartformer may be used with the following PV inverters by SMA:

- Sunny Boy 2000HF-US / 2500HF-US / 3000HF-US
- Sunny Boy 3000-US / 3800-US / 4000-US
- Sunny Boy 5000-US / 6000-US
- In off-grid systems: Sunny Boy 7000-US / 8000-US

A generator or the power distribution grid may be connected to the Smartformer. The generator or the power distribution grid may supply the Sunny Island system with 120 V on 1 line conductor or with 240 V on 2 line conductors. A generator and the power distribution grid may only be connected to the Smartformer at the same time if used with an external automatic transfer switch.

General terms of use:

Only use the Smartformer in accordance with the information provided in the enclosed documentation. Any other use can result in personal injury or property damage.

The enclosed documentation is an integral part of this product.

- Read and adhere to the documentation.
- Keep the documentation in a convenient place for future reference.

Do not operate the Smartformer if it has technical defects.

For safety reasons, it is forbidden to modify the product or install components that are not explicitly recommended or distributed by SMA.

2.2 Qualification of Skilled Workers

The tasks described in this document are intended for skilled workers only. Skilled workers must have the following skills:

- Knowledge about the functional principle and operation of off-grid systems and backup systems
- Knowledge of how to deal with the dangers and risks associated with installing and using electrical devices
- Knowledge of the installation and commissioning of electrical devices
- Knowledge of all applicable standards and guidelines
- Knowledge of and adherence to this document and all safety precautions

2.3 Safety Precautions

⚠ DANGER

Danger to life due to electric shock

High voltages that can result in electric shocks are present in the live components of the Smartformer.

- Disconnect the Smartformer from the power supply before performing any work on the Smartformer (see Section 10).
- Always use a contact hazard protection cover when operating the Smartformer.
- Work on the Smartformer may only be performed by a skilled worker.
- Do not touch live components of the Smartformer or other components of the Sunny Island system.

⚠ WARNING

Risk of injury due to moving parts

A generator can be started automatically by the Sunny Island. Moving parts in the generator can crush or sever body parts.

- Only operate the generator with safety equipment provided by the manufacturer.
- Install, maintain, and operate the generator according to the manufacturer's specifications.

⚠ CAUTION

Risk of injury due to hot components

Components inside the Smartformer may become hot during operation. This may result in burns to the body.

- Always use a contact hazard protection cover when operating the Smartformer.
- Allow the Smartformer to cool down before removing the contact hazard protection cover.

NOTICE

Property damage due to moisture and dust intrusion

The Smartformer corresponds to the NEMA 1 degree of protection when it is closed and is only suitable for indoor installation. The intrusion of dust and moisture into the interior can damage the Smartformer.

- Protect the Smartformer against moisture and dust.
- After working on the Smartformer, mount the contact hazard protection cover and close the Smartformer.
- While the Smartformer is open, protect it against dust and water.

3 Scope of Delivery

Check the delivery for completeness and any externally visible damage. Contact your specialty retailer if the delivery is incomplete or you find any damage.

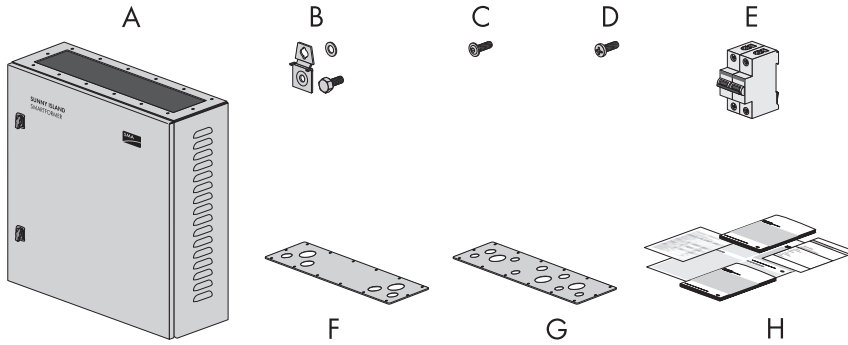


Figure 2: Components included in delivery

Position	Quantity	Description
A	1	Smartformer
B	4	Anchorage bracket, sealing ring, and hexagon head screw M6x8
C	4	Hexagon socket screw M8x12
D	28	Phillips screw PZ 2
E	1	2-pole miniature circuit-breaker 25 A
F	1	Upper flange plate
G	1	Lower flange plate
H	1	Installation manual technical description*

* Information about the circuitry of the Smartformer in the Sunny Island can be found in the technical description.

4 Product Description

4.1 Smartformer for Sunny Island

The Smartformer for Sunny Island is a pre-wired AC distribution board with an autotransformer, bypass switch, load-shedding contactor, overload protection, and miniature circuit-breakers.

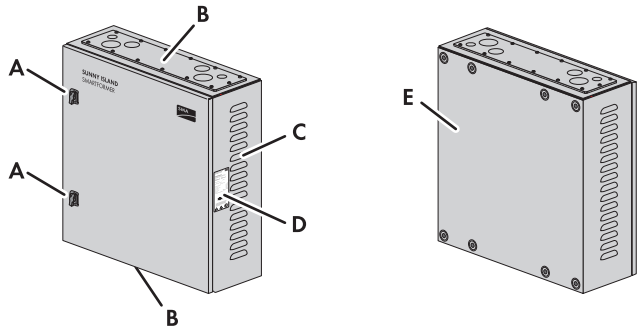
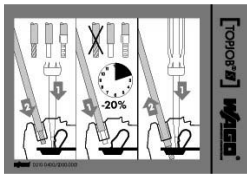


Figure 3: Structure of the Smartformer

Position	Description
A	Door handles
B	Flange plate
C	Ventilation slots
D	Type label
E	Rear wall of enclosure with 8 drill holes

The Smartformer is the AC distribution board in a Sunny Island system with 1 Sunny Island. The Smartformer provides the terminals for all components in the Sunny Island system. The Smartformer expands the scope of functions of the Sunny Island with the autotransformer, bypass switch, load-shedding contactor, overload protection, and miniature circuit-breakers.

Symbols on the Smartformer

Symbol	Description	Explanation
	Spring clamp terminals	Some of the terminals of the Smartformer are executed as spring clamp terminals. Always connect a conductor to a spring clamp terminal as described in this document (see Section 6.5 "Connecting Insulated Conductors to Spring Clamp Terminals", page 39).

4.2 Autotransformer

The autotransformer enables the following functions in a Sunny Island:

- Integration of PV inverters with an AC output voltage of 240 V
- Supply of AC loads with 120 V or 240 V

The autotransformer converts the input voltage according to the load requirements, operating in the step-up and step-down operating modes.

- Step-up:

  The Sunny Island makes an AC input voltage of 120 V available. The autotransformer converts this AC input voltage into an AC output voltage of 240 V. The loads use one AC output with 120 V or both AC outputs with 240 V. A different load on the two 120 V outputs is compensated by the Smartformer through power transmission.

- Step-down:

  The PV inverter makes an AC input voltage of 240 V available. The autotransformer converts this AC input voltage into an AC output voltage 120 V. The Sunny Island uses this voltage to load the battery.

Unlike in other transformers, the input circuit and the output circuit of the autotransformer are not galvanically isolated.

4.3 Bypass Switch

The bypass switch is a manual automatic transfer switch that makes it possible to directly supply the loads through the generator or power distribution grid. By directly supplying the loads through the generator or power distribution grid, the Smartformer bypasses the terminals of the PV plant and Sunny Island. In this way, the Smartformer simplifies maintenance work and repairs.

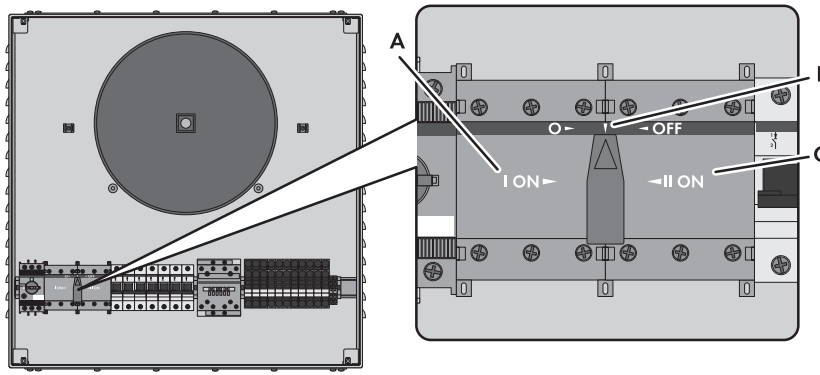


Figure 4: Overview of the bypass switch

Position	Description	Explanation
A	Switch position "I ON"	The Sunny Island supplies the loads and, in doing so, integrates the generator or power distribution grid, along with the PV plant.
B	Switch position "O OFF"	The loads are not supplied with voltage.
C	Switch position "II ON"	Generators or power distribution grids supply the loads directly.

4.4 Load-Shedding Contactor

The load-shedding contactor is an automatic switch-off device used to protect the battery from deep discharge.

When a predefined charge status limit of the battery is reached, the Sunny Island triggers the load-shedding contactor. The load-shedding contactor disconnects the loads from the Sunny Island system. By doing so, the Sunny Island prevents deep battery discharge.

4.5 Miniature Circuit-Breaker

The miniature circuit-breakers protect the connected conductors against destruction due to overheating. Each of the miniature circuit-breakers can be manually activated or can be tripped automatically.

To be able to trip automatically, each miniature circuit-breaker monitors the electric current in the connected conductors. When the current becomes too high, the miniature circuit-breaker interrupts the flow of current and thus prevents overheating of the conductors.

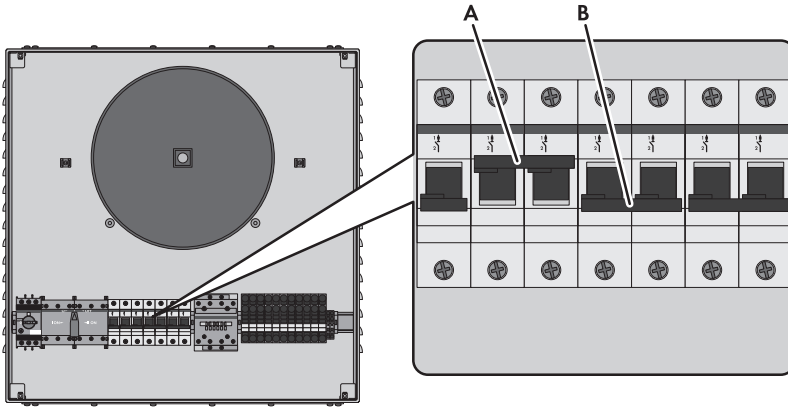


Figure 5: Overview of the miniature circuit-breakers

Position	Description	Explanation
A	Upper switch position	The miniature circuit-breaker is closed.
B	Lower switch position	The miniature circuit-breaker is open.

4.6 Overload Protection

The overload protection protects the autotransformer against damage from overheating or a short circuit. The overload protection identifies overheating or a short circuit by monitoring the currents in the autotransformer. If currents become too high, the overload protection is tripped with a predefined time delay. The time delay prevents tripping of the overload protection during brief switch-on current peaks.

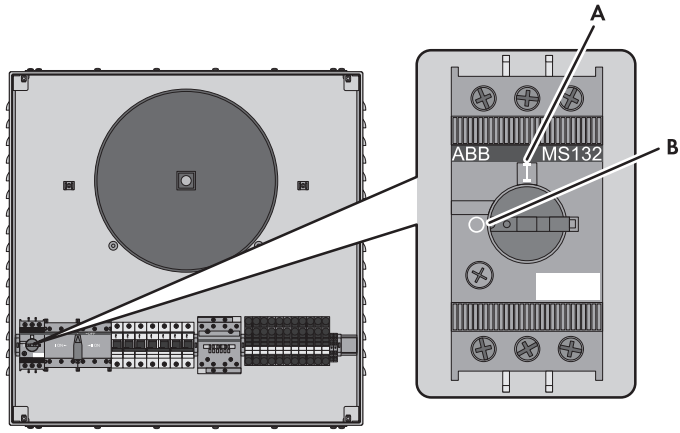


Figure 6: Overview of the overload protection

Position	Description	Explanation
A	Switch position "1"	The overload protection is in its normal operating state. Current is flowing through the primary side and the secondary side of the autotransformer.
B	Switch position "0"	The overload protection has been tripped. The current flow is interrupted on the secondary side of the transformer.

4.7 Type Label

The type label provides a unique identification of the Smartformer. The type label is on the right-hand side of the enclosure.

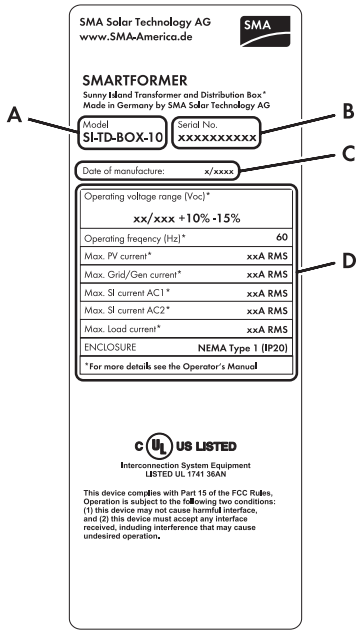

A
B
C
D
SMA Solar Technology AG
www.SMA-America.de
SMA
SMARTFORMER
Sunny Island Transformer and Distribution Box*
Made in Germany by SMA Solar Technology AG
Model
SI-TD-BOX-10
Serial No.
xxxxxxxxxx
Date of manufacture: x/xxxx
Operating voltage range (Voc)*
xx/xxx +10% -15%
Operating freqency (Hz)* 60
Max. PV current* xxA RMS
Max. Grid/Gen current* xxA RMS
Max. SI current AC1* xxA RMS
Max. SI current AC2* xxA RMS
Max. Load current* xxA RMS
ENCLOSURE NEMA Type 1 (IP20)
*For more details see the Operator's Manual
c UL US LISTED
Interconnection System Equipment
LISTED UL 1741 36AN
This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) this device may not cause harmful interface,
and (2) this device must accept any interface
received, including interference that may cause
undesired operation.

Figure 7: Layout of the type label

Position	Description	Explanation
A	Model	Device type
B	Serial No.	Serial number of the Smartformer
C	Date of manufacture	–
D	Device-specific characteristics	–

5 Mounting

5.1 Selecting the Mounting Location

⚠ WARNING

Danger to life due to fire or explosion

Despite careful construction, electrical devices can cause fires.

- Do not mount the Smartformer on flammable construction materials.
- Do not mount the Smartformer near highly flammable materials.
- Do not mount the Smartformer in potentially explosive atmospheres.

Danger to life due to electric shock

Penetrating moisture may result in voltage being applied to parts of the mounting location.

- Do not mount the Smartformer outdoors.

NOTICE

Destruction of the Smartformer due to direct solar irradiation

Direct solar irradiation can damage the paintwork on the Smartformer enclosure and lead to enclosure corrosion.

- Ensure that the Smartformer is not exposed to direct solar irradiation.

Requirements for the mounting location:

☐ A firm surface must be available for mounting, such as a masonry wall, studs, or posts. In living areas, make sure that the surface is not made of plasterboard or similar. The Smartformer makes noises when in use, which can be regarded as a nuisance.

☐ The mounting location must be suitable for the weight and dimensions of the Smartformer (see Section 14 "Technical Data", page 64).

☐ The mounting location is clear and has safe access at all times without any additional aids being necessary (such as scaffolding or lifting platforms). Non-fulfillment of these criteria may restrict servicing.

☐ The ambient conditions are met (see Section 14 "Technical Data", page 64). This ensures optimal operation of the Smartformer.

☐ The mounting location must not be exposed to direct solar irradiation.

Observe minimum clearances:

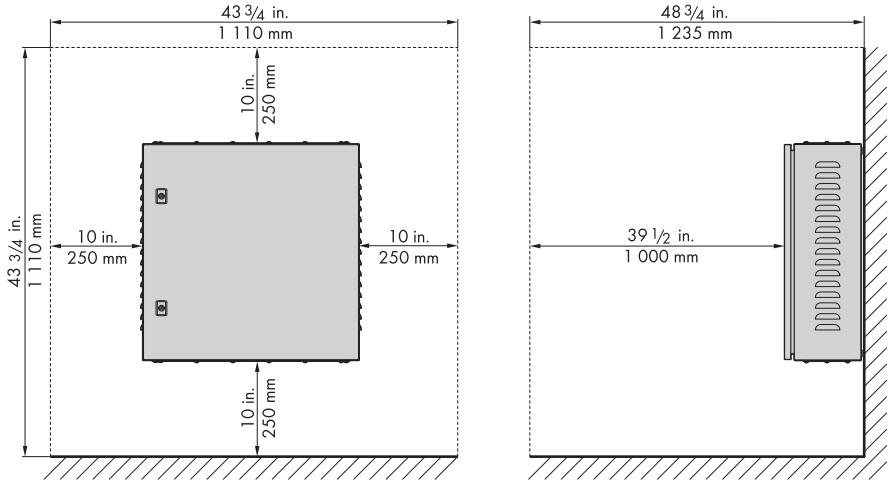


Figure 8: Minimum clearances

NOTICE

Destruction of the Smartformer due to insufficient heat dissipation

The Smartformer can overheat if there is insufficient heat dissipation. Frequent overheating can destroy the Smartformer in the long term.

- Maintain the minimum clearance to walls and adjacent devices or objects. As a result, sufficient heat dissipation is ensured.
- If the Smartformer is installed together with other electrical devices in areas with high ambient temperatures, increase the distances between the Smartformer and the other electrical devices and provide a sufficient fresh-air supply. This prevents the Smartformer from drawing in the exhaust air from adjacent devices.

- Make sure that there is a distance of at least 39 1/2 in. (1 000 mm) between the door of the Smartformer and any obstacle in front of it. This makes it easier to open the door of the Smartformer.

Selecting the positions of the anchorage brackets on the enclosure rear wall:

Before mounting the anchorage brackets, select 1 of the following 3 options for positioning the anchorage brackets. This determines the position of the 4 drill holes.

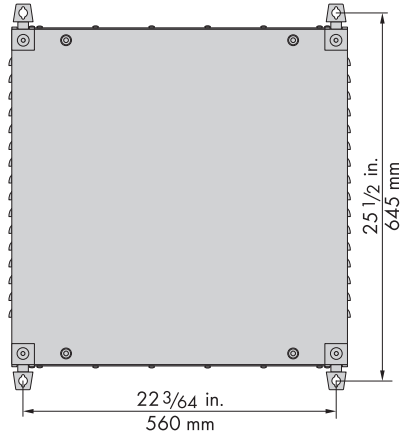


Figure 9: Dimensions with outer drill holes and vertical position of anchorage brackets

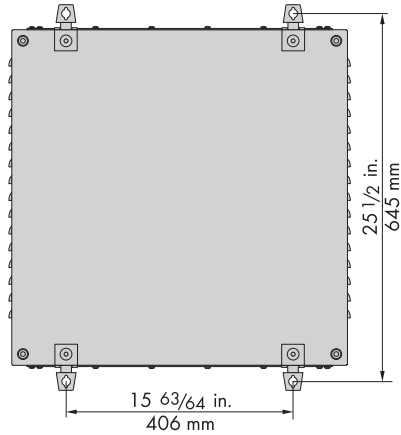


Figure 10: Dimensions with inner drill holes and vertical position of anchorage brackets

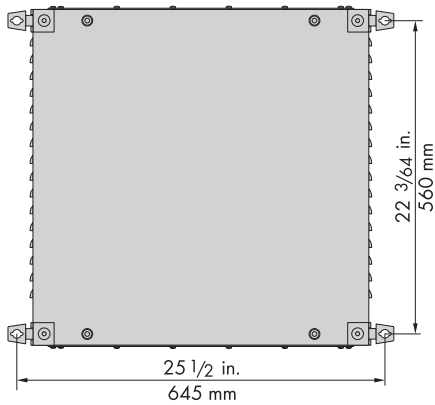


Figure 11: Dimensions with outer drill holes and horizontal position of anchorage brackets

- When mounting the Smartformer on a wooden wall, ensure that the distance between the middle of one stud and the middle of the next stud equals the horizontal distance between the drill holes.

Observe permitted mounting position:

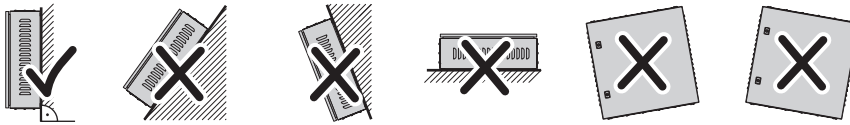


Figure 12: Permitted mounting position and prohibited mounting position

- Mount the Smartformer in the permitted mounting position.
- Position the upper enclosure side horizontally. Tip: Use a spirit level.

5.2 Mounting the Anchorage Brackets on the Enclosure Rear Wall

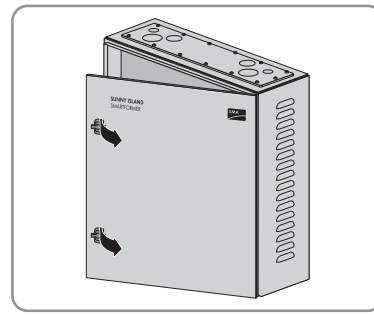
⚠ CAUTION

Risk of injury due to falling Smartformer

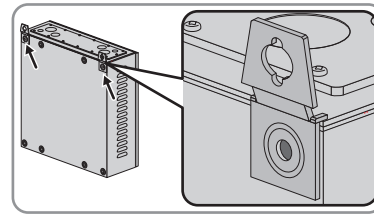
Due to its heavy weight, the Smartformer can crush or break bones if it falls.

- When mounting, take into account the weight of the Smartformer, which is 132 1/2 lbs. (60 kg).
- Make sure that the Smartformer does not tilt or move out of position during mounting.

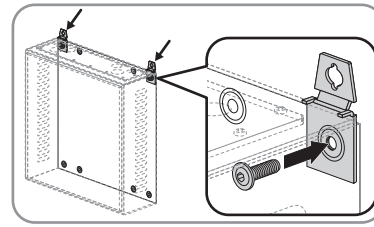
1. Place the Smartformer on a firm substructure and open the enclosure door using the door handles.



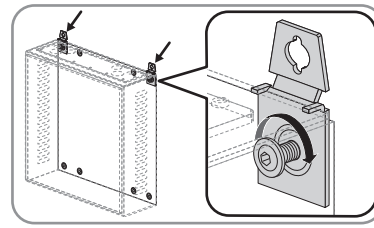
2. Disassemble the contact hazard protection cover (see Section 9.1).
3. 2 position anchorage brackets on the upper drill holes in the enclosure rear wall. When doing so, keep the anchorage brackets in the chosen position and align the metal bars of the anchorage bracket with the enclosure door.



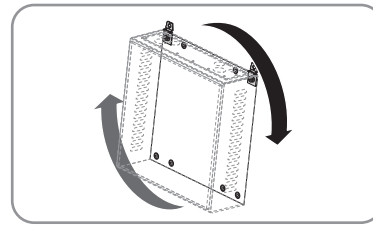
4. Screw on both anchorage brackets:
   - Insert the hexagon socket screw with the sealing ring through the drill hole from the inside and into the thread of the anchorage bracket.



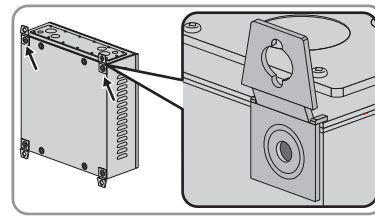
- Tighten the hexagon socket screw (torque: 88 in-lbs. (10 Nm)).
  Use a torque wrench with an attachment for hexagon socket screws $^{3}/_{16}$ in. (5 mm).



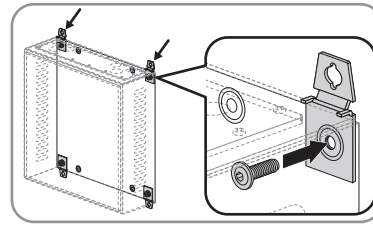
5. Turn the Smartformer by 180°.



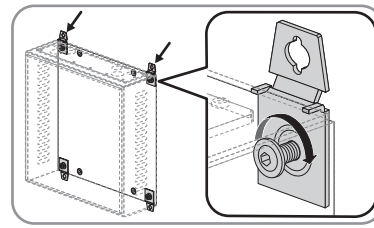
6. 2 position anchorage brackets on the upper drill holes in the enclosure rear wall. When doing so, keep the anchorage brackets in the chosen position and align the metal bars of the anchorage bracket with the enclosure door.



7. Screw on both anchorage brackets.
   - Insert the hexagon socket screw with the sealing ring through the drill hole from the inside and into the thread of the anchorage bracket.



   - Tighten the hexagon socket screw (torque: 88 in-lbs. (10 Nm)).
     Use a torque wrench with an attachment for hexagon socket screws $^{3}/_{16}$ in. (5 mm).



5.3 Mounting the Smartformer on a Masonry Wall

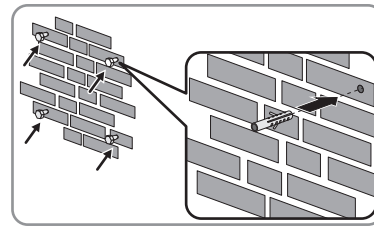
Additional required mounting material (not included in the scope of delivery):

- ☐ 4 screws that are suitable for the mounting substructure and the weight of the Smartformer (minimum diameter: $^{5}/_{16}$ in. (8 mm), minimum length: $1^{1}/_{2}$ in. (40 mm)).
- ☐ 4 screw anchors that are suitable for the mounting substructure and the size of the screws.

Requirements:

- ☐ The mounting location must be defined.
- ☐ The 4 anchorage brackets must be mounted on the enclosure rear wall.

1. Mark the positions of the 4 drill holes on the wall. Adhere to the dimensions of the Smartformer with the mounted anchorage brackets (see Section 5.1 "Selecting the Mounting Location", page 22).
2. Ensure that there are no electric lines or other supply lines in the wall behind the marked positions.
3. Drill the holes. Ensure that the diameter of each drill hole matches the diameter of the screw anchor.
4. Insert 4 screw anchors into the drill holes.



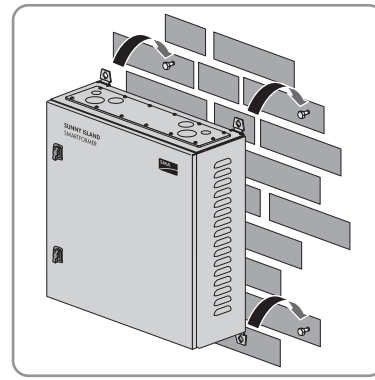
5. Screw the screws into the wall. Allow the screw heads to protrude at least $^{3}/_{8}$ in. (10 mm) from the wall.

6. **⚠ CAUTION**

Risk of injury due to falling Smartformer

Due to its heavy weight, the Smartformer can crush or break bones if it falls.

- Hang the Smartformer onto the screws and carefully slide it into the guides of the anchorage brackets. When doing so, note that the weight of the Smartformer is 132 1/2 lbs. (60 kg) and make sure that the Smartformer does not tilt or slip out of place during mounting.



7. Tighten the screws in the wall firmly. Use a torque wrench with a suitable attachment and adhere to the maximum torque specified for the screws used.

5.4 Mounting the Smartformer on a Wooden Wall

Additional required mounting material (not included in the scope of delivery):

☐ 4 screws that are suitable for the mounting substructure and the weight of the Smartformer (minimum diameter: 5/16 in. (8 mm), minimum length: 1 1/2 in. (40 mm)).

Requirements:

☐ The mounting location must be defined.

☐ The 4 anchorage brackets must be mounted on the enclosure rear wall.

☐ The 4 anchorage brackets must be positioned so that each drill hole can be drilled into a stud.

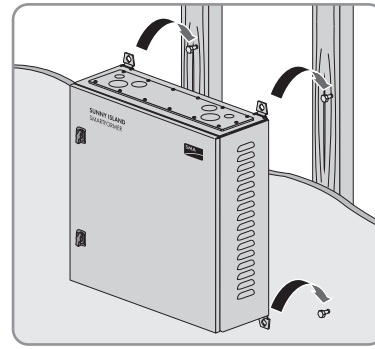
1. Mark the positions of the 4 drill holes on the wall. Adhere to the dimensions of the Smartformer with the mounted anchorage brackets (see Section 5.1 "Selecting the Mounting Location", page 22).
2. Ensure that there are no electric lines or other supply lines in the wall behind the marked positions.
3. Drill the holes. The diameter of each drill hole must be approx. 1 mm smaller than the diameter of the screws used.
4. Screw the screws into the wall. Allow the screw heads to protrude at least 3/8 in. (10 mm) from the wall.

5. **⚠ CAUTION**

Risk of injury due to falling Smartformer

Due to its heavy weight, the Smartformer can crush or break bones if it falls.

- Hang the Smartformer onto the screws and carefully slide it into the guides of the anchorage brackets. When doing so, note that the weight of the Smartformer is $132\frac{1}{2}$ lbs. (60 kg) and make sure that the Smartformer does not tilt or slip out of place during mounting.



6. Tighten the screws in the wall firmly. Use a torque wrench with a suitable attachment and adhere to the maximum torque specified for the screws used.

6 Electrical Connection

6.1 Safety during Electrical Connection

⚠ DANGER

Danger to life due to electric shock

High voltages that can result in electric shocks are present in the live components of the Smartformer.

- Disconnect the Smartformer from the power supply before performing any work on the Smartformer (see Section 10).
- Always use a contact hazard protection cover when operating the Smartformer.
- Work on the Smartformer may only be performed by a skilled worker.
- Do not touch live components of the Smartformer or other components of the Sunny Island system.

⚠ WARNING

Risk of lethal electric shock due to faulty grounding

There may be only 1 conducting connection between N and PE in the entire Sunny Island system. Any further connections disturb the fault current detection and can lead to electric shock.

- Establish 1 connection between N and PE in the AC main distribution unit. Observe the National Electrical Code®, ANSI/NFPA 70 and all local standards and regulations that may apply.
- Make sure that there are no other connections between N and PE in the entire Sunny Island system.

NOTICE

Destruction of the Smartformer due to cables coming loose

The insulated conductors can become detached from the terminals due to their heavy weight, thereby damaging or destroying the Smartformer.

- Use cable conduits to insert the cables into the Smartformer.
- Use the cable clamps within the Smartformer to clamp the cables.

6.2 Overview of the Connection Area

6.2.1 View from Below

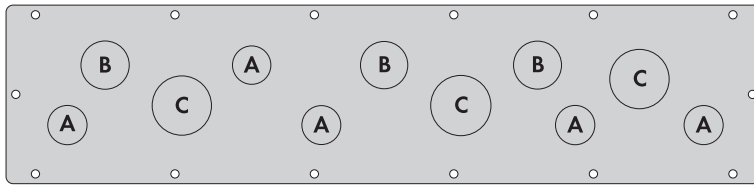


Figure 13: Flange plate with knockouts on the bottom of the Smartformer

Position	Description	Suitable conduit for connection (diameter)
A	Knockouts	$^{3}/_{4}$ in. (19 mm)
B	Knockouts	1 in. (25 mm)
C	Knockouts	$1\,^{1}/_{4}$ in. (32 mm)

6.2.2 View from Above

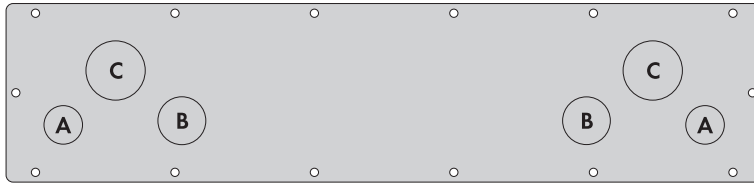


Figure 14: Flange plate with knockouts on the upper side of the Smartformer

Position	Description	Suitable conduit for connection (diameter)
A	Knockouts	$^{3}/_{4}$ in. (19 mm)
B	Knockouts	1 in. (25 mm)
C	Knockouts	$1\,^{1}/_{4}$ in. (32 mm)

6.2.3 Interior View

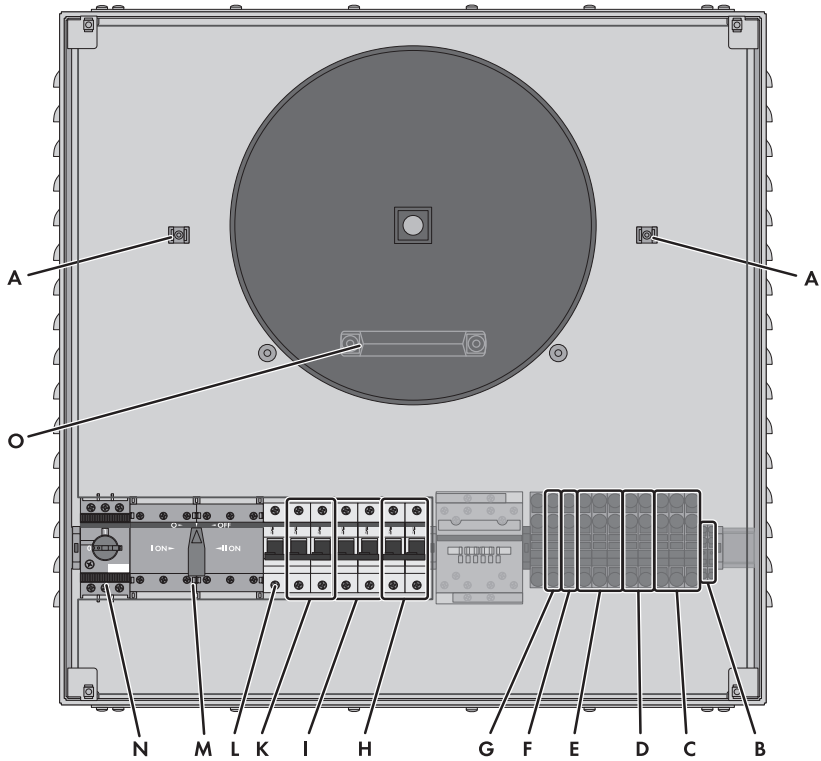


Figure 15: Electrical connection area of the Smartformer

Position	Description	Color	Explanation
A	Cable clamps	–	For clamping the cables when cables are inserted via the upper flange plate.
B	Connecting terminal blocks "Relay2: C", "Relay2: NC" with spring clamp terminals	Black	For connecting the Sunny Island to the load-shedding contactor in the Smartformer
C	Connecting terminal blocks "Grounding" with spring clamp terminals	Yellow/ green	For connecting PE of the AC sub-distribution for the loads, the PV plant, the Sunny Island, and the generator or the power distribution grid and for grounding the protection against contact

Position	Description	Color	Explanation
D	Connecting terminal blocks"Load L1", "Load L2" with spring clamp terminals	Black/red	For connecting L1 and L2 of the AC sub-distribution for the loads
E	Connecting terminal blocks "Neutral N" with spring clamp terminals	Gray	For connecting N of the AC sub-distribution for the loads, the PV plant, the Sunny Island, and the generator or the power distribution grid
F	Connecting terminal blocks "Sunny Island AC2 L" with spring clamp terminals	Black	For connecting L of the AC 2 terminal of Sunny Island
G	Connecting terminal blocks "Sunny Island AC1 L" with spring clamp terminals	Black	For connecting L of the AC 1 terminal of Sunny Island
H	2-pole miniature circuit-breaker "F6" and "F7" with screw terminals "Grid or Generator L/L1", "Grid or Generator L2"	Black/red	For connecting L or L1 and L2 of the generator or for connecting L1 and L2 of the power distribution grid
I	2-pole miniature circuit-breaker "F4" and "F5" with screw terminals "Sunny Boy L1", "Sunny Boy L2"	Black/red	For connecting L1 and L2 of the PV plant
K	2-pole miniature circuit-breaker "F2" and "F3"	–	See Section 4.5
L	1-pole miniature circuit-breaker "F1"		See Section 4.5
M	Bypass switch	–	See Section 4.3
N	Overload protection	–	See Section 4.6
O	Contact hazard protection cover*	–	Contact hazard protection cover with 6 anchorage points

* The contact hazard protection cover is shown as semi-transparent.

6.2.4 System Overview

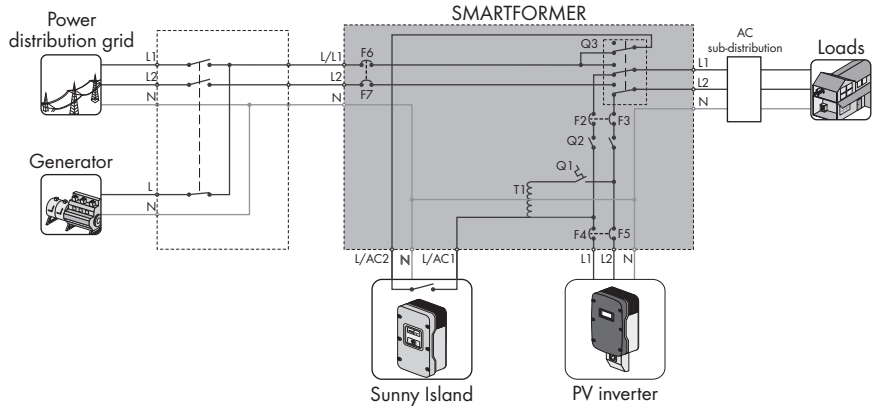


Figure 16: Smartformer system overview

Position	Description	Explanation
"T1"	Autotransformer	See Section 4.2 "Autotransformer", page 17
"Q1"	Overload protection	See Section 4.6 "Overload Protection", page 20
"Q2"	Load-shedding contactor	See Section 4.4 "Load-Shedding Contactor", page 18
"Q3"	Bypass switch	See Section 4.3 "Bypass Switch", page 18
"F2"	2-pole miniature circuit-breaker	When the bypass switch is set to "I ON", "F2" and "F3" protect the loads.
"F3"		
"F4"	2-pole miniature circuit-breaker	"F4" and "F5" protect the PV inverters.
"F5"		
"F6"	2-pole miniature circuit-breaker	When the bypass switch is set to "II ON", "F6" protects the loads and the generator. When the bypass switch is set to "I ON", "F6" protects the AC 2 output of the Sunny Island.
"F7"		When the bypass switch is set to "II ON", "F7" protects the loads and the generator.
ATS	Automatic Transfer Switch	Automatic transfer switch: not included in scope of delivery

6.3 Selecting Cables

Cable requirements:

- ☐ Conductor material: copper
- ☐ Conductor structure: solid wire, coarse stranded wire, or fine stranded wire
- ☐ The cable must be approved for 167°F (75°C).
- ☐ Maximum wire size: 4 AWG

Minimum wire sizes

Components for connection	Minimum wire size
Loads	6 AWG
PV plant with miniature circuit-breaker 25 A	10 AWG
PV plant with miniature circuit-breaker 50 A	6 AWG
Generator or power distribution grid	6 AWG
Sunny Island: AC 1 terminal	4 AWG*
Sunny Island: AC 2 terminal	6 AWG

* Valid for Sunny Island 4548-US / 6048-US and for Sunny Island 5048-US with labeling "Smartformer compatible" on the original packaging

- Make sure that the general cable requirements are adhered to.
- Make sure that minimum and maximum wire sizes are adhered to.

If you connect a Sunny Island 5048-US without labeling "Smartformer compatible" on the original packaging, observe the following procedure:

- Select a wire size of 6 AWG for the AC 1 connection cable of the Sunny Island.
- Fuse the AC 1 connection cable of the Sunny Island outside of the Smartformer. Use a 60 A miniature circuit-breaker, for example.
- In order to avoid excessive tripping of the 60 A miniature circuit-breaker, limit the rated power of the loads to 5.8 kW.

6.4 Inserting the Cables

Insert each cable into the Smartformer according to the following procedure.

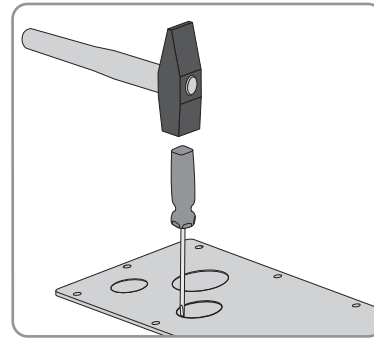
⚠ CAUTION

Risk of injury due to cable fire

Hot fluids that arise during a cable fire can emerge from the open knockouts in the bottom flange plate.

- Make sure that all knockouts that have be opened for introducing cables are in use.
- Close unused knockouts with a suitable material.

1. Open the Smartformer using the two door handles.
2. Disassemble the contact hazard protection cover (see Section 9.1).
3. Select the conduit that matches the external diameter of the chosen cable (see Section 6.2.1 or Section 6.2.2). Take the *National Electrical Code®*, ANSI/NFPA 70, and all locally applicable standards and regulations into consideration.
4. Select the flange plate for inserting the cable:
   - To introduce the cable from below into the Smartformer, select the lower flange plate.
   - To introduce the cable from above into the Smartformer, select the upper flange plate.
5. Select the knockout that matches the conduit (see Section 6.2.1 and Section 6.2.2).
6. Open the selected knockout using a hammer and screwdriver. Tip: Open all knockouts for the upper or lower flange plate before reinserting the flange plates.



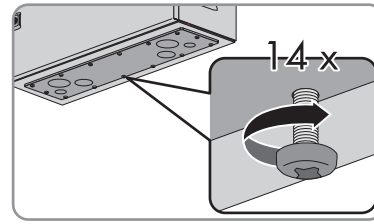
7. ***NOTICE***

   Destruction of the thread if flange plate is mounted multiple times

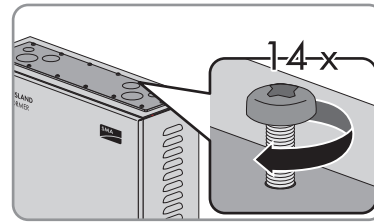
   When they are being screwed in, the PZ 2 screws cut a thread into the Smartformer enclosure. Screwing them in more than once destroys this thread. This means that the flange plates are no long screwed tight.

   - Make sure that all required knockouts have been opened before the flange plate is mounted.
   - The flange plates must not be screwed to the enclosure more than once.

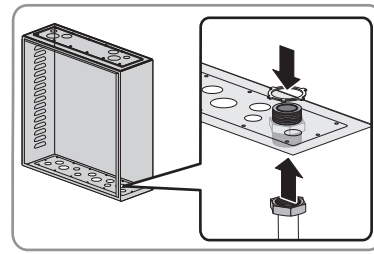
8. Insert the flange plates into the Smartformer:
   - Hold the lower flange plate against the Smartformer enclosure and tighten the 14 PZ 2 screws (torque: 25 in-lbs. (2.8 Nm)). Use a torque wrench with a PZ 2 attachment or another suitable cross-head screwdriver attachment.



   - Hold the upper flange plate against the Smartformer enclosure and tighten the 14 PZ 2 screws (torque: 25 in-lbs. (2.8 Nm)). Use a torque wrench with a PZ 2 attachment or another suitable cross-head screwdriver attachment.



9. Install the cable conduit between the Smartformer and the components being connected.
10. Attach the conduit on the inside of the Smartformer with a counter nut.



11. If a metal cable conduit is used, ground the cable conduit according to the locally applicable standards and regulations. Tip: You can use a vacant terminal of the "Grounding" connecting terminal plate to ground the conduit.
12. Insert the cable of the components being connected through the cable conduit into the Smartformer.
13. If the cable is being introduced into the Smartformer from above, attach the cable with a cable tie to one of the cable clamps. Use a cable length that reaches to the specified terminal.
14. Make sure that all opened knockouts are closed again.

6.5 Connecting Insulated Conductors to Spring Clamp Terminals

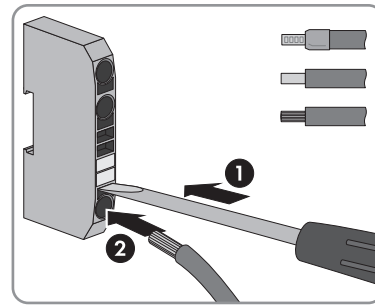
Some of the terminals of the Smartformer are executed as spring clamp terminals. Always use the following procedure when connecting an insulated conductor to a spring clamp terminal. A different procedure applies for connecting the insulated conductors on the load-shedding contactor (see Section 6.10 "Connecting the Load-Shedding Contactor", page 44).

Required tools:

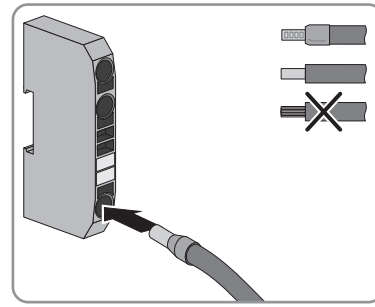
☐ Screwdriver (maximum blade width: 5.5 mm)

1. Insert the cable (see Section 6.4).
2. Remove the coating.
3. Shorten insulated conductors by at least $^{3}/_{8}$ in. (10 mm). This removes any damaged or corroded conductor material.
4. Strip the insulation of the insulated conductors by $^{3}/_{4}$ in. (19 mm).
5. Route the insulated conductors to the connecting terminal plate provided.
6. Connect the conductors to the spring clamp terminals. Note that there is 1 possible procedure for a conductor with a bootlace ferrule and 1 possible procedure for a conductor made of coarse stranded wire or solid wire:

   - To connect a conductor with a bootlace ferrule, a conductor made of coarse stranded wire or solid wire, or a conductor made of fine stranded wire, push a screwdriver into the terminal contact of the spring clamp terminal and insert the conductor into the terminal up to the limit position.



   - To connect a conductor with a bootlace ferrule or a conductor made of coarse stranded wire or solid wire, push the conductor into the terminal up to the limit position.



6.6 Connecting Loads

There are two ways to connect loads.

- AC main distribution unit:

  In a backup system, some of the loads can be connected to the AC main distribution unit. The generator or the power distribution grid directly supplies all loads connected to the AC main distribution unit. These loads are not integrated into the Sunny Island system.

- AC sub-distribution:

  In a stand-alone grid, all loads are connected to the AC sub-distribution behind the Smartformer. The Smartformer and the Sunny Island supply the loads connected to the AC sub-distribution behind the Smartformer.

This section describes the connection of the AC sub-distribution for the loads to the Smartformer.

Connecting loads to the AC sub-distribution

The power requirement of the loads should be designed in accordance with the nominal power of the Sunny Island.

- To minimize the transmission losses, connect frequently used loads or loads with a high power consumption to the "Load L1" terminal block via the AC sub-distribution. The requirement of the loads should not exceed a nominal current of 32 A at "Load L1".
- If the Sunny Island with power distribution grid or generator is the only power supply, all loads connected to terminal block "Load L2" are supplied via the autotransformer, which is fused with 32 A.
- The continual requirement of the loads should not exceed a nominal current of 28 A at "Load L2".

1. Connect the PE conductor to a vacant spring clamp terminal of a "Grounding" connecting terminal plate (see Section 6.5).
2. Connect the N conductor to a vacant spring clamp terminal of a "Neutral N" connecting terminal plate (see Section 6.5).
3. Connect the L1 conductor to the lower spring clamp terminal of the "Load L1" connecting terminal plate (see Section 6.5).
4. Connect the L2 conductor to the lower spring clamp terminal of the "Load L2" connecting terminal plate (see Section 6.5).

6.7 Connecting the PV Plant

⚠ WARNING

Danger to life due to fire in incorrectly connected PV inverter

An excessive current load can overheat the AC connection of the PV inverter and cause a cable fire.

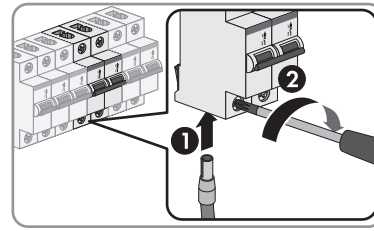
- Protect the AC output of each PV inverter according to the maximum permissible AC electrical current strength (see the PV inverter installation manual).
- If 1 PV inverter is connected to the Sunny Island system, protect the PV inverter with miniature circuit-breakers "F4" and "F5" of the Smartformer.
- If several PV inverters are connected to the Sunny Island system, install the AC sub-distribution for the PV plant according to the locally applicable standards and regulations, and protect the PV inverters individually.
- When selecting the wire size, consult the PV inverter installation manual and adhere to the locally applicable standards and regulations.

PV inverter	Rated current	Replace the miniature circuit-breaker?
Sunny Boy 2000HF-US / 2500HF-US / 3000HF-US	25 A	Yes: see Section 12.2
Sunny Boy 3000-US / 3800-US / 4000-US	25 A	Yes: see Section 12.2
Sunny Boy 5000-US / 6000-US	50 A	No*
In stand-alone grids: Sunny Boy 7000-US /8000-US	50 A	No*

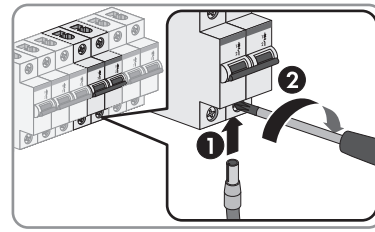
* The "F4" and "F5" miniature circuit-breakers of the Smartformer are preinstalled with 50 A on delivery.

1. Make sure that each PV inverter is protected in the Smartformer or in the AC sub-distribution of the PV plant according to its rated current (see the PV inverter installation manual).
2. Connect the PE conductor to a vacant spring clamp terminal of a "Grounding" connecting terminal plate (see Section 6.5).
3. Connect the N conductor to a vacant spring clamp terminal of a "Neutral N" connecting terminal plate (see Section 6.5).
4. Shorten insulated conductors L1 and L2 and strip the insulation by $^{3}/_{8}$ in. (10 mm).

5. Connect the L1 conductor to the lower screw terminal "Sunny Boy L1" of the miniature circuit-breaker "F4" and tighten screw (torque: 25 in-lbs. (2.8 Nm)). Use a torque wrench with a PZ 2 attachment or another suitable cross-head screwdriver attachment.



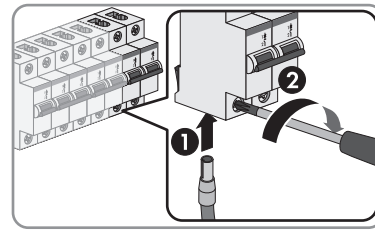
6. Connect the L2 conductor to the lower screw terminal "Sunny Boy L2" of the miniature circuit-breaker "F5" and tighten screw (torque: 25 in-lbs. (2.8 Nm)). Use a torque wrench with a PZ 2 attachment or another suitable cross-head screwdriver attachment.



6.8 Connecting the Generator or Power Distribution Grid

When connecting to the power distribution grid, proceed as described below for the generator.

1. Connect the PE conductor to a vacant spring clamp terminal of a "Grounding" connecting terminal plate (see Section 6.5).
2. Connect the N conductor to a vacant spring clamp terminal of a "Neutral N" connecting terminal plate (see Section 6.5).
3. To connect a single-phase generator, connect conductor L of the generator.
   - Strip the insulation of insulated conductor L by $^{3}/_{8}$ in. (10 mm).
   - Connect the L conductor to the lower screw terminal "Grid or Generator L/L1" of the miniature circuit-breaker "F6" and tighten screw (torque: 25 in-lbs. (2.8 Nm)). Use a torque wrench with a PZ 2 attachment or another suitable cross-head screwdriver attachment.



4. **NOTICE**

   Destruction of the generator due to uneven power reduction

   If the connected loads are supplied by the Sunny Island, the Smartformer only transfers the power provided by the split-phase generator via L1. This uneven power reduction may destroy the generator.

   - Make sure that the split-phase generator being used is approved for uneven power reduction (see manufacturer's documentation for the generator).

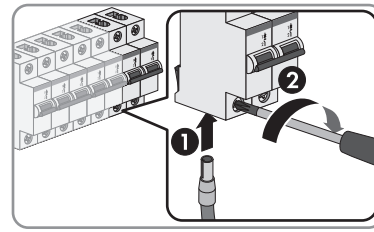
     or

   - Connect 1-phase generator.

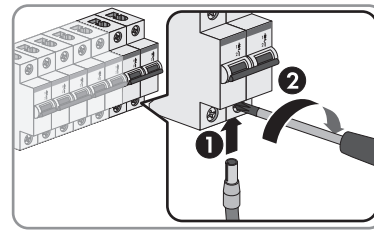
     or

   - Also install 1 Smartformer or an autotransformer.

5. To connect a split-phase generator, connect conductors L1 and L2 of the generator:
   - Strip the insulation of insulated conductors L1 and L2 by $^{3}/_{8}$ in. (10 mm).
   - Connect the L1 conductor to the lower screw terminal "Grid or Generator L/L1" of miniature circuit-breaker "F6" and tighten screw (torque: 25 in-lbs. (2.8 Nm)). Use a torque wrench with a PZ 2 attachment or another suitable cross-head screwdriver attachment.



   - Connect the L2 conductor to the lower screw terminal "Grid or Generator L2" of the miniature circuit-breaker "F7" and tighten screw (torque: 25 in-lbs. (2.8 Nm)). Use a torque wrench with a PZ 2 attachment or another suitable cross-head screwdriver attachment.



6.9 Connecting the Sunny Island

1. Connect each of the PE conductors to a vacant spring clamp terminal of a "Grounding" connecting terminal plate (see Section 6.5).
2. Connect each of the N conductors to a vacant spring clamp terminal of a "Neutral N" connecting terminal plate (see Section 6.5).
3. Connect the L conductor of the AC 1 terminal of the Sunny Island to the lower spring clamp terminal of the "Sunny Island AC1 L" connecting terminal plate (see Section 6.5).
4. Connect the L conductor of the AC 2 terminal of the Sunny Island to the lower spring clamp terminal of the "Sunny Island AC2 L" connecting terminal plate (see Section 6.5).

6.10 Connecting the Load-Shedding Contactor

Cable requirements:

- ☐ Conductor material: copper
- ☐ Minimum wire size: 18 AWG
- ☐ Maximum wire size: 14 AWG
- ☐ The cable must be approved for 167°F (75°C).
- ☐ The cable must be approved for AC 120 V.

Selecting a wire size:

- Choose the dimension of the wire size according to the maximum electrical current strength which occurs at the terminals of the Smartformer (maximum electrical current strength: AC 3 A).

Overview:

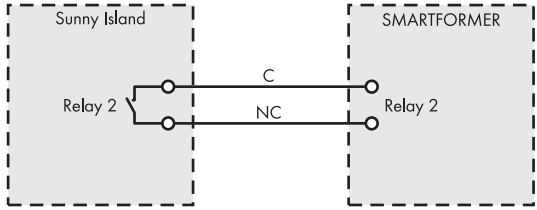


Figure 17: Connecting the load-shedding contactor to the Sunny Island

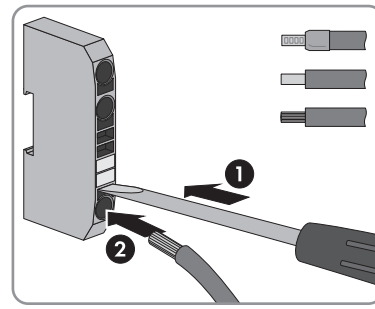
Required tools:

- ☐ Screwdriver (maximum blade width: 2.5 mm)

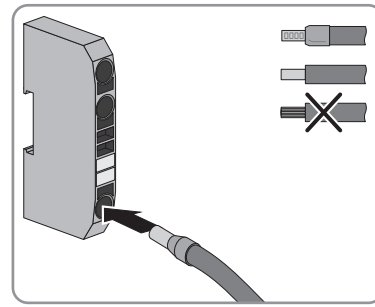
1. Insert 2 insulated conductors into the Sunny Island and route to the terminal of the multi-function relay 2 (see technical description of the Sunny Island).
2. Connect both insulated conductors to the 3-pin terminal supplied with the Sunny Island. Use the contacts "C" and "NC" and label the insulated conductors accordingly.
3. Tighten the terminals (torque: 5 in-lbs. ... 7 in-lbs. (0.56 Nm ... 0.79 Nm)).
4. Insert the terminal into the "Relay 2" connection in the Sunny Island.
5. Introduce both insulated conductors into the Smartformer (see Section 6.4).
6. Shorten both insulated conductors and strip the insulation by $^{3}/_{8}$ in. (10 mm).

7. Connect the NC conductor to the lower spring clamp terminal of the "Relay2: NC" connecting terminal plate. Note that there is 1 possible procedure for a conductor with a bootlace ferrule and 1 possible procedure for a conductor made of coarse stranded wire or solid wire:

   - To connect a conductor with a bootlace ferrule, a conductor made of coarse stranded wire or solid wire, or a conductor made of fine stranded wire, push a screwdriver into the terminal contact of the spring clamp terminal and insert the conductor into the terminal up to the limit position.



   - To connect a conductor with a bootlace ferrule or a conductor made of coarse stranded wire or solid wire, push the conductor into the terminal up to the limit position.



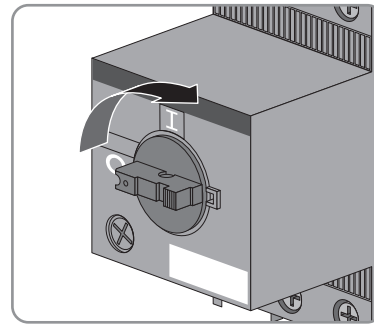
8. Connect the C conductor to the lower spring clamp terminal of the "Relay2: C" connecting terminal plate. Proceed as described in step 7.

7 Commissioning

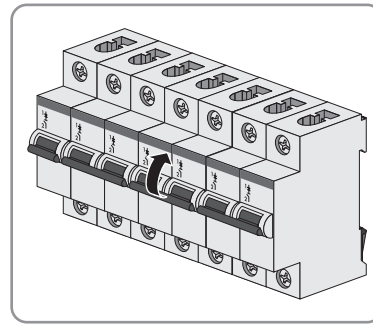
Requirements:

- ☐ The Smartformer must be mounted properly.
- ☐ All conduits must be correctly installed and attached.
- ☐ All lines must be connected correctly.
- ☐ The contact hazard protection cover must be mounted.
- ☐ All knockouts in the flange plates must be closed.
- ☐ The bypass switch must be set to **O OFF**.
- ☐ The overload protection must be set to **0**.
- ☐ The switches of the miniature circuit-breakers "F1" to "F7" must be in the lower position.
- ☐ The generator must be switched off.
- ☐ There must be no connection to the power distribution grid.

1. Start the Sunny Island (see technical description of the Sunny Island).
2. Start the PV inverters (see the PV inverter installation manual).
   ☑ The PV inverters check the grid conditions.
3. Set the PV inverters to stand-alone operation (see the PV inverter installation manual).
4. Set the overload protection to **1**.



5. Move the switches of miniature circuit-breakers "F4" and "F5" to the upper position.

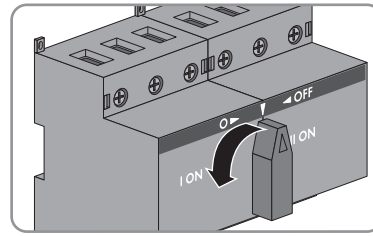


6. Check whether the PV plant feeds into the Sunny Island system.

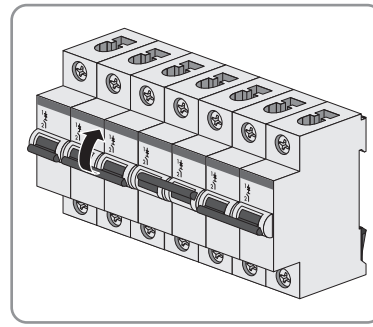
   If the PV plant does not feed into the Sunny Island system, check the installation of the Smartformer:

   - Check the connection of the Sunny Island to the Smartformer (see Section 6.9).
   - Check the connection of the PV plant to the Smartformer (see Section 6.7).

7. Set the bypass switch to **I ON**.



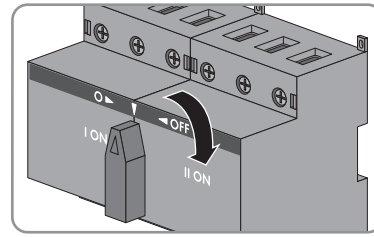
8. Move the switches of miniature circuit-breakers "F2" and "F3" to the upper position.



9. Check whether the loads are being supplied with voltage.

   If the loads are not being supplied with voltage, check the connection of the loads to the Smartformer (see Section 6.6).

10. Set the bypass switch to **II ON**.

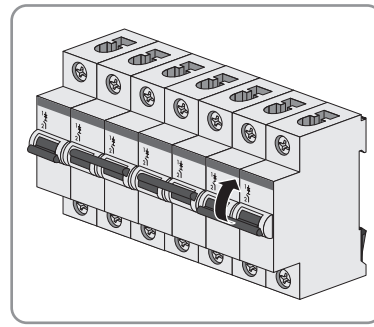


11. Check whether the bypass switch interrupts the supply to the loads.

    If the loads continue to be supplied with voltage, check the connection of the loads to the Smartformer (see Section 6.6).

12. Start the generator or connect the power distribution grid.

13. Move the switches of miniature circuit-breakers "F6" and "F7" to the upper position.

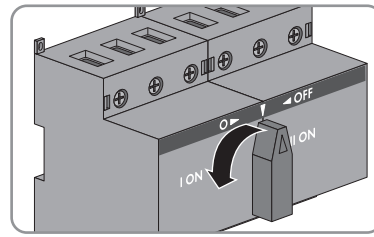


14. Check whether the generator or the power distribution grid is supplying the loads with voltage.

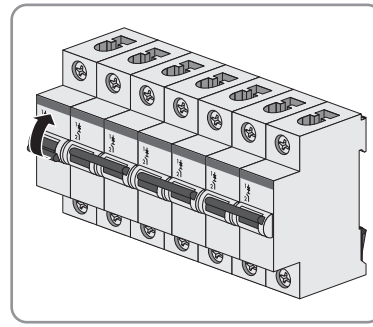
    If the loads are not being supplied with voltage, check the connection of the generator or the power distribution grid to the Smartformer (see Section 6.8).

15. Set the bypass switch to **I ON**.

    ☑ The Sunny Island synchronizes with the generator or the power distribution grid and takes over supply of the loads.



16. Move the switch of miniature circuit-breaker "F1" to the upper position.

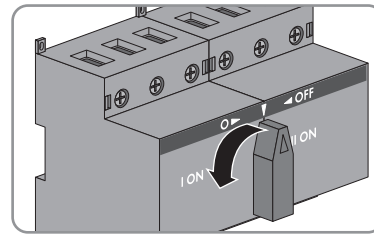


17. If the load-shedding contactor is connected, set the parameter "241.02 Rly2Op" on the Sunny Island to **Off** (see technical description of the Sunny Island). This triggers the load-shedding contactor of the Smartformer.
18. Check whether the load-shedding contactor interrupts the supply of the loads.

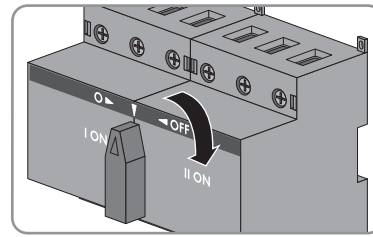
    If the load-shedding contactor does not interrupt the supply of the loads, check the connection of the load-shedding contactor to the Sunny Island (see Section 6.10 "Connecting the Load-Shedding Contactor", page 44).
19. If the load-shedding contactor is connected, set the parameter "241.02 Rly2Op" on the Sunny Island to **AutoLodExt** (see technical description of the Sunny Island). This is used to set the desired function of the load-shedding contactor.

8 Setting the Operating Mode via the Bypass Switch

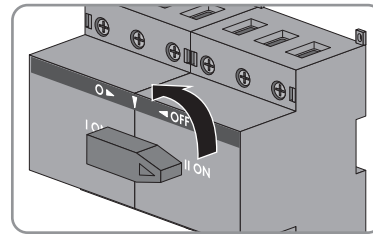
- To have the connected loads supplied by the Sunny Island, set the bypass switch to **I ON**.



- To have the connected loads supplied only by the generator or power distribution grid, set the bypass switch to **II ON**.



- To switch off the supply of the loads, set the bypass switch to **O OFF**.



9 Mounting and Disassembling the Contact Hazard Protection Cover

⚠ DANGER

Danger to life due to electric shock

High voltages that can result in electric shocks are present in the live components of the Smartformer.

- Disconnect the Smartformer from the power supply before performing any work on the Smartformer (see Section 10).
- Always use a contact hazard protection cover when operating the Smartformer.
- Work on the Smartformer may only be performed by a skilled worker.
- Do not touch live components of the Smartformer or other components of the Sunny Island system.

⚠ CAUTION

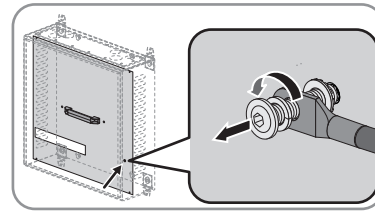
Risk of burns due to hot components

Components inside the Smartformer may become hot during operation.

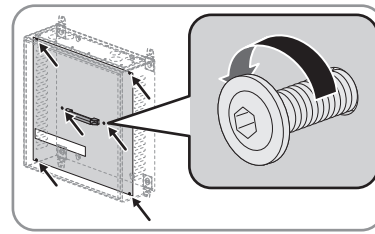
- Always use a contact hazard protection cover when operating the Smartformer.
- Allow the Smartformer to cool down before removing the contact hazard protection cover.

9.1 Disassembling the Contact Hazard Protection Cover

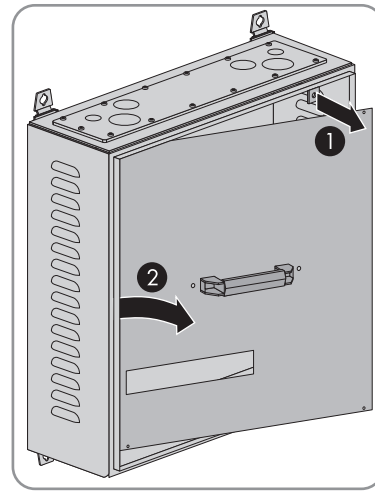
1. Disconnect the Smartformer from the power supply (see Section 10).
2. Ensure that the Smartformer has cooled down.
3. Release the fastening screw of the grounding cable. Keep the fastening screw, split lock washer, and contact washer safe.



4. Release 6 fastening screws of the contact hazard protection cover.



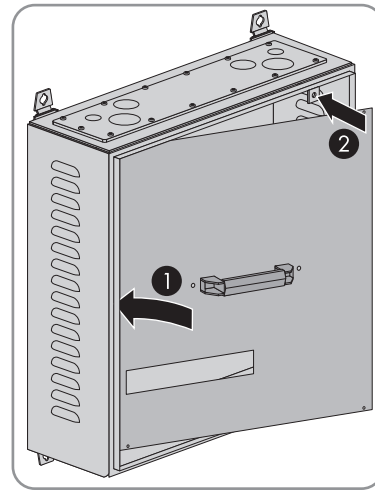
5. Pull the right side of the contact hazard protection cover forwards and, with the cover at an angle, remove the contact hazard protection cover in a straight movement forwards out of the Smartformer. Do not touch any components or terminals in doing so.



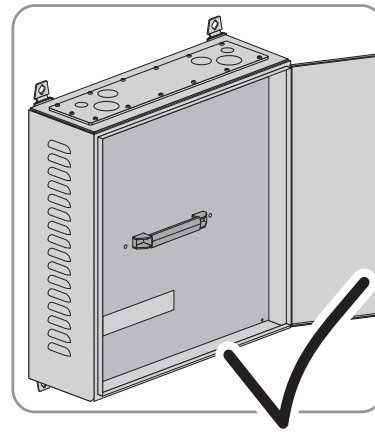
6. Secure the terminal lug of the grounding cable with adhesive tape to the bottom right of the Smartformer enclosure wall.

9.2 Mounting the Contact Hazard Protection Cover

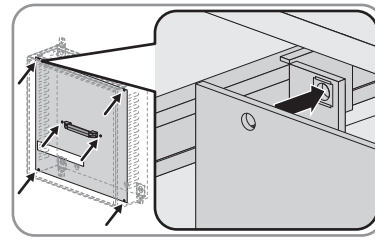
1. Ensure that the Smartformer is disconnected from the power supply (see Section 10).
2. Position the left side of the contact hazard protection cover against the right-hand side of the Smartformer and, with the cover at an angle to the left, push back the contact hazard protection cover in a straight movement. Do not touch any components or terminals in doing so.



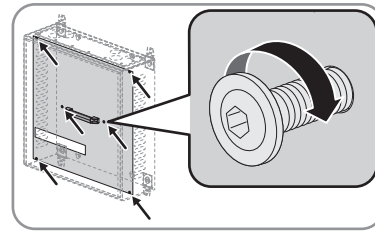
3. Lower the right-hand side of the contact hazard protection cover towards the back.
   ☑ Contact hazard protection cover is in place in the Smartformer.



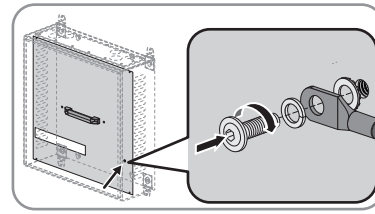
4. Align the contact hazard protection cover with the 6 spacers. The mounting openings of the contact hazard protection cover must be positioned directly above the inner threads of the spacers.



5. Tighten the 6 fastening screws of the contact hazard protection cover (torque: 45 in-lbs. (5 Nm). Use a torque wrench with an attachment for hexagon-socket screws $^{3}/_{16}$ in. (5 mm).

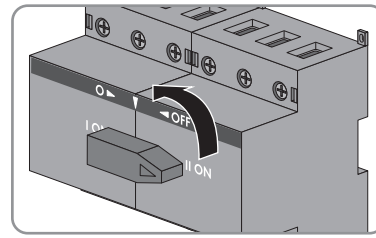


6. Mount the split lock washer, terminal lug, and contact washer onto the screw and tighten (torque: 45 in-lbs. (5 Nm)). Use a torque wrench with an attachment for hexagon-socket screws $^{3}/_{16}$ in. (5 mm).

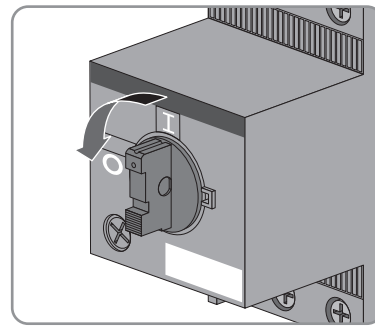


10 Disconnecting the Smartformer from the Power Supply

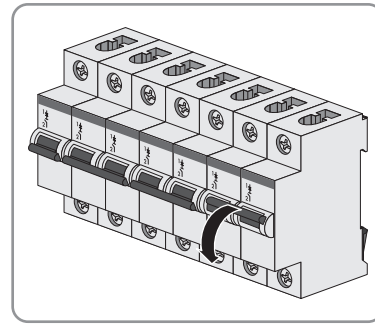
1. Switch off the loads.
2. Set the bypass switch to **O OFF**.



3. Set the overload protection to **0**.



4. Move the switch of miniature circuit-breakers "F1" to "F7" to the lower position.



5. If there is a PV array, switch off the PV array and ensure that it cannot be reconnected (see the PV array manual).
6. If there is a power distribution grid, switch off the power supply from the power distribution grid and ensure that it cannot be reconnected. Follow the instructions from the local grid operator.
7. Disconnect the PV inverter from the power supply (see PV inverter manual).

8. **⚠ WARNING**

   Risk of lethal electric shock due to unnoticed start of the Sunny Island

   The Sunny Island can start on its own from standby.

   - Disconnect the Sunny Island from the power supply (see technical description of the Sunny Island).

9. Ensure that the Sunny Island system with the Smartformer cannot be reconnected.
10. Ascertain that the Sunny Island system and the Smartformer are dead.
11. Ground and short circuit the Sunny Island system at the connection of the generator or the power distribution grid.
12. Cover or shield any adjacent live components.

11 Cleaning

Cleaning the enclosure

1. Check the Smartformer enclosure for externally visible damage.

   If the Smartformer enclosure exhibits externally visible damage, perform the following measures:

   - Take the Smartformer out of service (see Section 13 "Decommissioning", page 62).
   - Contact the SMA Service Line.
2. Remove coarse dirt contamination from the outside of the enclosure with a soft brush or similar tool.
3. ***NOTICE***

   Damage to Smartformer due to moisture penetration

   Moisture penetration can cause short circuits and damage to the Smartformer.

   - Use a moist cloth to remove dust from the outside of the enclosure. Do not use solvents, abrasives, or other corrosive substances.

Cleaning the ventilation slots

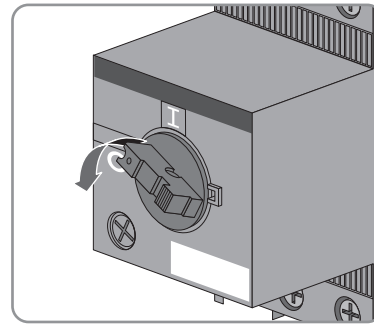
- If the ventilation slots of the Smartformer are dusty, clean them with a soft brush, hand brush, or similar tool.

12 Troubleshooting

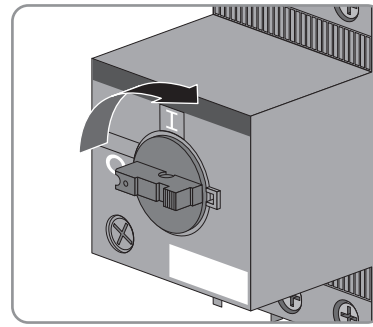
12.1 Activating Overload Protection

The overload protection of the Smartformer was tripped. Activate the overload protection using the following procedure.

1. Switch the overload protection to **0**.



2. Switch the overload protection to **1**.



☑ The overload protection stays set to **1** and the connected loads are supplied with voltage.

✖ What if the overload protection jumps back to a position between **0** and **1**?

Possible cause of fault: The temperature in the autotransformer is still too high.

- Wait at least 10 minutes.
- Switch the overload protection to **0**.
- Switch the overload protection to **1**.

Possible cause of fault: Too many loads are connected via "Load L2".

- Switch off individual loads.
- Connect more loads via "Load L1".

12.2 Replacing Miniature Circuit-Breakers "F4" and "F5"

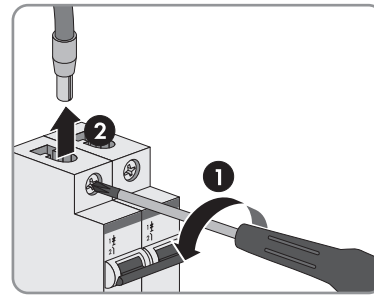
⚠ DANGER

Danger to life due to electric shock

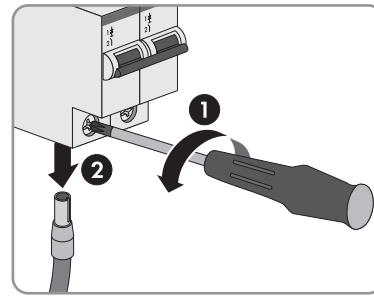
High voltages that can result in electric shocks are present in the live components of the Smartformer.

- Disconnect the Smartformer from the power supply before performing any work on the Smartformer (see Section 10).
- Always use a contact hazard protection cover when operating the Smartformer.
- Work on the Smartformer may only be performed by a skilled worker.
- Do not touch live components of the Smartformer or other components of the Sunny Island system.

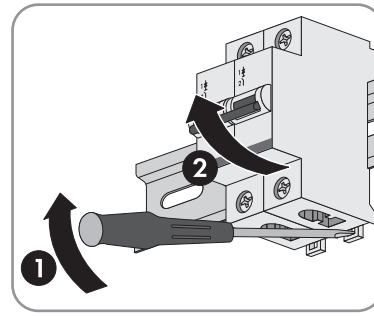
1. Release the upper screw terminals of miniature circuit-breakers "F4" and "F5" and remove the conductors. Use a PZ 2 screwdriver or a suitable cross-head screwdriver.



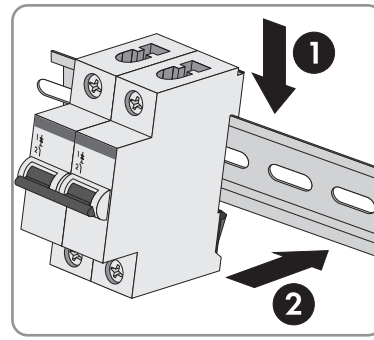
2. Release the lower screw terminals of miniature circuit-breakers "F4" and "F5" and remove the conductors. Use a PZ 2 screwdriver or a suitable cross-head screwdriver.



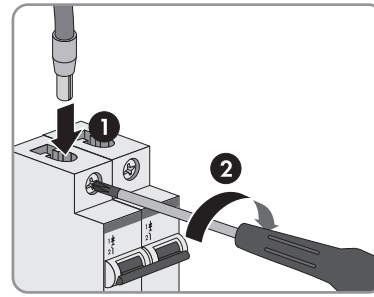
3. Use a screwdriver to release the locking lever of each miniature circuit-breaker and lift the miniature circuit-breaker off the top-hat rail.



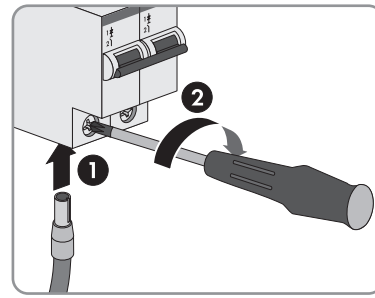
4. Ensure that the fuse rating of the new miniature circuit-breaker matches the maximum feed current of the PV plant of 25 A or 50 A.
5. Ensure that the miniature circuit-breaker is certified according to the specified UL standard and adheres to the specified tripping characteristic (see Section 14 "Technical Data", page 64).
6. Position the new miniature circuit-breaker at the top edge of the top-hat rail and press against the lower edge of the top-hat rail until the locking lever engages.



7. Insert the upper conductor into the upper screw terminal and tighten screws (torque: 25 in-lbs. (2.8 Nm)). Use a torque wrench with a PZ 2 attachment or another suitable cross-head screwdriver attachment.



8. Insert the lower conductor into the lower screw terminal and tighten screws (torque: 25 in-lbs. (2.8 Nm)). Use a torque wrench with a PZ 2 attachment or another suitable cross-head screwdriver attachment.



13 Decommissioning

13.1 Disassembling the Smartformer

⚠ DANGER

Danger to life due to electric shock

High voltages that can result in electric shocks are present in the conductive components of the Smartformer.

- Disconnect the Smartformer from the power supply before performing any work on the Smartformer (see Section 10).
- Work on the Smartformer may only be performed by a skilled worker.
- Do not touch live components of the Smartformer or other components of the Sunny Island system.

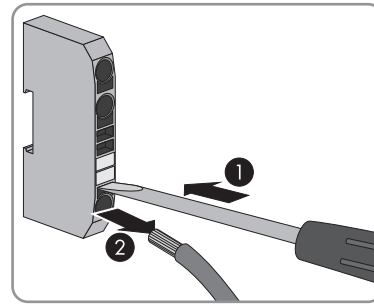
⚠ CAUTION

Risk of injury due to falling Smartformer

Due to its heavy weight, the Smartformer can crush or break bones if it falls.

- When disassembling, take into account the weight of the Smartformer, which is 132 ½ lbs. (60 kg).
- Make sure that the Smartformer does not tilt or move out of position during disassembly.

1. Disconnect the Smartformer from the power supply (see Section 10).
2. Wait for at least 1 hour, until the Smartformer has cooled down.
3. Open the enclosure door using the door handles.
4. Disassemble the contact hazard protection cover (see Section 9.1).
5. Release insulated conductors from all spring clamp terminals of the Smartformer. Insert a screwdriver into the terminal contact of the spring clamp terminal and pull the insulated conductor out of the spring clamp terminal.



6. Release insulated conductors from the screw terminals of the miniature circuit-breakers "F4", "F5", "F6" and "F7".
7. Remove all connection cables from the Smartformer.
8. Loosen 4 screws in the wall.
9. Take the Smartformer off the wall and set it down.
10. Unscrew 4 screws from the wall.
11. Release screws of the 4 anchorage brackets on the Smartformer and remove anchorage brackets.
12. Mount the contact hazard protection cover (see Section 9.2).
13. Close the enclosure door using the door handles.

13.2 Storing the Smartformer

- Store the Smartformer in a dry place where the ambient temperature is always between − 13°F (− 25°C) and +140°F (+60°C).
- Store the Smartformer in closed packaging.

13.3 Packaging the Smartformer

- Package the Smartformer and the 4 anchorage brackets. Use the original packaging for this or packaging suitable for the weight and dimensions of the Smartformer (see Section 14 "Technical Data", page 64).

13.4 Disposing of the Smartformer

- Dispose of the Smartformer in accordance with the locally applicable disposal regulations for electronic waste.

  or

- Send the Smartformer to SMA at your own expense (see Section 16 "Contact", page 71). When doing so, label the packaging with the information "FOR DISPOSAL".

14 Technical Data

General data

Number of phases	1-phase / split phase
Nominal power of the transformer*	3.4 kVA
AC power of the transformer for 30 minutes*	4.4 kVA
AC power of the transformer for 1 minute*	8.8 kVA
Typical self-consumption in no-load operation	19 W
Maximum self-consumption in no-load operation	23.3 W
Maximum efficiency	99.0%
CEC efficiency	98.8%
Certification	UL
Permissible grounding systems	TN
Width x height x depth	24 in. x 24 in. x $9\frac{1}{4}$ in. (610 mm x 610 mm x 235 mm)
Weight	$132\frac{1}{2}$ lbs. (60 kg)
Width x height x depth of packaging	$27\frac{1}{4}$ in. x $27\frac{5}{8}$ in. x $12\frac{5}{8}$ in. (690 mm x 700 mm x 320 mm)

* Power that the transformer can transfer from one line conductor to the other line conductor.

Efficiency curve

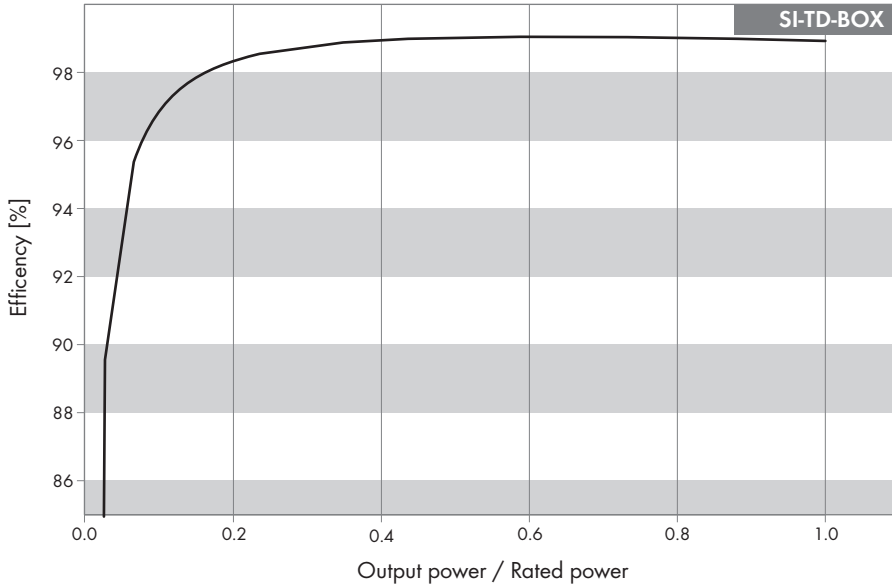


Figure 18: Efficiency curve of Smartformer

Ambient conditions

Ambient temperature	– 25°C ... 50°C (– 13°F ... 122°F)
Maximum value for relative humidity, non-condensing	100%
Protection class	NEMA 1
Enclosure degree of protection	IP20
Contact hazard protection cover degree of protection	IP10
Overvoltage category	3
EMC environment	FCC Part 15

Possible conduits for connection

Top with diameter $^{3}/_{4}$ in. (19 mm)	2
Top with diameter 1 in. (25 mm)	2
Top with diameter $1^{1}/_{4}$ in. (32 mm)	2
Bottom with diameter $^{3}/_{4}$ in. (19 mm)	5
Top with diameter 1 in. (25 mm)	3
Bottom with diameter $1^{1}/_{4}$ in. (32 mm)	3

Miniature circuit-breakers in use

Designation in Smartformer	Nominal AC current	Tripping characteristics	Certification	Version
Miniature circuit-breaker "F1"	3 A	Z	UL 489	1-pole
Miniature circuit-breaker "F2"	40 A	K	UL 489	2-pole
Miniature circuit-breaker "F3"	40 A	K	UL 489	
Miniature circuit-breaker "F4"	25 A/50 A	Z	UL 489	2-pole
Miniature circuit-breaker "F5"	25 A/50 A	Z	UL 489	
Miniature circuit-breaker "F6"	60 A	K	UL 489	2-pole
Miniature circuit-breaker "F7"	60 A	K	UL 489	

AC 1 terminal of Sunny Island

Number of devices	1 Sunny Island
Nominal AC voltage	120 V
Rated power	7.2 kW
AC power at 104°F (40°C)	6.7 kW
AC power at 122°F (50°C)	6.0 kW
AC current at rated power	60 A
AC current at 104°F (40°C)	55.7 A
AC current at 122°F (50°C)	49.6 A
Number of phases	1-phase
Connection type	Spring clamp terminal
Wire size*	4 AWG

* Valid for Sunny Island 4548-US / 6048-US and for Sunny Island 5048-US with labeling "Smartformer compatible" on the original packaging

AC 2 terminal of Sunny Island

Number of devices	1 Sunny Island
Nominal AC voltage	120 V
Rated power	5.8 kW
AC power at 104°F (40°C)	5.0 kW
AC power at 122°F (50°C)	4.5 kW
AC current at rated power	48 A
AC current at 104°F (40°C)	41.6 A
AC current at 122°F (50°C)	37.9 A
Number of phases	1-phase
Connection type	Spring clamp terminal
Maximum wire size	4 AWG
Minimum wire size	6 AWG
Fuse type	Miniature circuit-breaker
Miniature circuit-breaker used in Smartformer	"F6"

Connection to power distribution grid/generator

Nominal AC voltage	120 V/240 V
Rated grid input power	11.5 kW
AC input power at 104°F (40°C)	10 kW
AC input power at 122°F (50°C)	9.1 kW
AC current at rated grid input power	48 A
AC current at 104°F (40°C)	41.6 A
AC current at 122°F (50°C)	37.9 A
Connection type	Spring clamp terminal/screw terminal
Maximum wire size	4 AWG
Minimum wire size	6 AWG
Torque for screw terminal	25 in-lbs. (2.8 Nm)
Fuse type	Miniature circuit-breaker
Miniature circuit-breakers used in Smartformer	"F6" and "F7"

PV plant connection

Nominal AC voltage	240 V
Rated power	9.6 kW
AC power at 104°F (40°C)	8.3 kW
AC power at 122°F (50°C)	7.6 kW
Maximum AC power for parallel grid operation to power distribution grid	6 kW
AC current at rated power	40 A
AC current at 104°F (40°C)	34.6 A
AC current at 122°F (50°C)	31.6 A
Connection type	Spring clamp terminal / screw terminal
Maximum wire size	4 AWG
Minimum wire size at 25 A*	10 AWG
Minimum wire size at 50 A*	6 AWG
Torque for screw terminal	25 in-lbs. (2.8 Nm)
Fuse type	Miniature circuit-breaker
Miniature circuit-breakers used in Smartformer	"F4" and "F5"

* Nominal current of miniature circuit-breakers "F4" and "F5"

Load connection: General data

Nominal AC voltage	120 V / 240 V
Rated grid voltage between L1 and N	120 V
AC voltage range between L1 and N	102 V ... 132 V
Rated grid voltage between L2 and N	120 V
AC voltage range between L2 and N	102 V ... 132 V
Rated grid voltage between L1 and L2	240 V
AC voltage range between L1 and L2	204 V ... 264 V
Nominal frequency	60 Hz
Frequency range	55 Hz ... 65 Hz
Connection type	Spring clamp terminal
Maximum wire size	4 AWG
Minimum wire size	6 AWG
Fuse type	Miniature circuit-breaker

Load connection: If bypass switch is set to "I ON"

Rated power	7.2 kW
Rated power between L1 and L2	6.7 kW
Rated power between L1 and N	3.8 kW
Rated power between L2 and N	3.4 kW
AC current to L1 at rated power	32 A
AC current to L2 at rated power	28 A
AC power between L1 and L2 at 104°F (40°C)	6.6 kW
AC power between L1 and N at 104°F (40°C)	3.3 kW
AC power between L2 and N at 104°F (40°C)	3.3 kW
AC current to L1 at 104°F (40°C)	27.7 A
AC current to L2 at 104°F (40°C)	27.7 A
AC power between L1 and L2 at 122°F (50°C)	5.8 kW
AC power between L1 and N at 122°F (50°C)	3.0 kW
AC power between L2 and N at 122°F (50°C)	2.9 kW
AC current to L1 at 122°F (50°C)	25.3 A
AC current to L2 at 122°F (50°C)	24.3 A
Miniature circuit-breakers used in the Smartformer for fusing	"F2" and "F3"

Load connection: If bypass switch is set to "II ON"

Rated power	11.5 kW
AC power at 104°F (40°C)	10 kW
AC power at 122°F (50°C)	9.1 kW
AC current at rated power	2 x 48 A
AC current at 104°F (40°C)	2 x 41.6 A
AC current at 122°F (50°C)	2 x 37.9 A
Miniature circuit-breakers used in the Smartformer for fusing	"F6" and "F7"

15 Compliance Information

FCC Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class A & B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

The user is cautioned that changes or modifications not expressly approved by SMA America, LLC could void the user's authority to operate this equipment.

16 Contact

If you encounter technical problems with our products, contact the SMA Service Line. We require the following information in order to provide you with the necessary assistance:

- Serial number of the Smartformer
- Sunny Island type, serial number and firmware version
- PV inverter serial number and type
- Wind energy inverter serial number and type
- Type and rated capacity of the connected battery

If a generator is connected:

  - Type
  - Power
  - Maximum current

- Type and power consumption of the connected loads

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